TECHNICAL REPORT NO. 74-49

MODIFIED GRAPNEL WITH LINE

by

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Final Report

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This program was conducted by the US Army Land Warfare Laboratory to correct the shortcomings and deficiencies which developed during US Army Test and Evaluation Command (USATECOM) Engineer Tests and Service Tests (ET/ST) of the Grapnel with Line Propelled LWL Task 03-F-67. Development of the initial system is described in Technical Report No. LWL-CR-03F67. In addition the US Army Combat Development Command (USAACDC) requested that the Grapnel System be modified so it could be fired from the M-203 Grenade Launcher as well as from the M-79 Grenade Launcher.

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INTRODUCTION

A lightweight, compact, individually operated grapnel system is needed to provide US Forces with a device to facilitate the movement of personnel across streams, walls, ravines, canyons, cliffs and mountainous areas during patrols, raids and rescue operations.

This rocket propelled grapnel system (see Figure 1) has a range of 175 to 225 ft horizontally and 140 to 165 ft vertically. To facilitate carrying, the grapnel system is divided into two bandoleer assemblies, the line bandoleer and the grapnel bandoleer (see Figure 2). The line bandoleer (see Figure 3) contains 400 ft of nylon rope, the grapnel bandoleer (see Figure 4) contains the grapnel hook and six rocket motors.

This report covers the modifications made to meet deficiencies and short-comings which appeared during ET/ST and modifications made to fire the system from the M-203 Grenade Launcher.

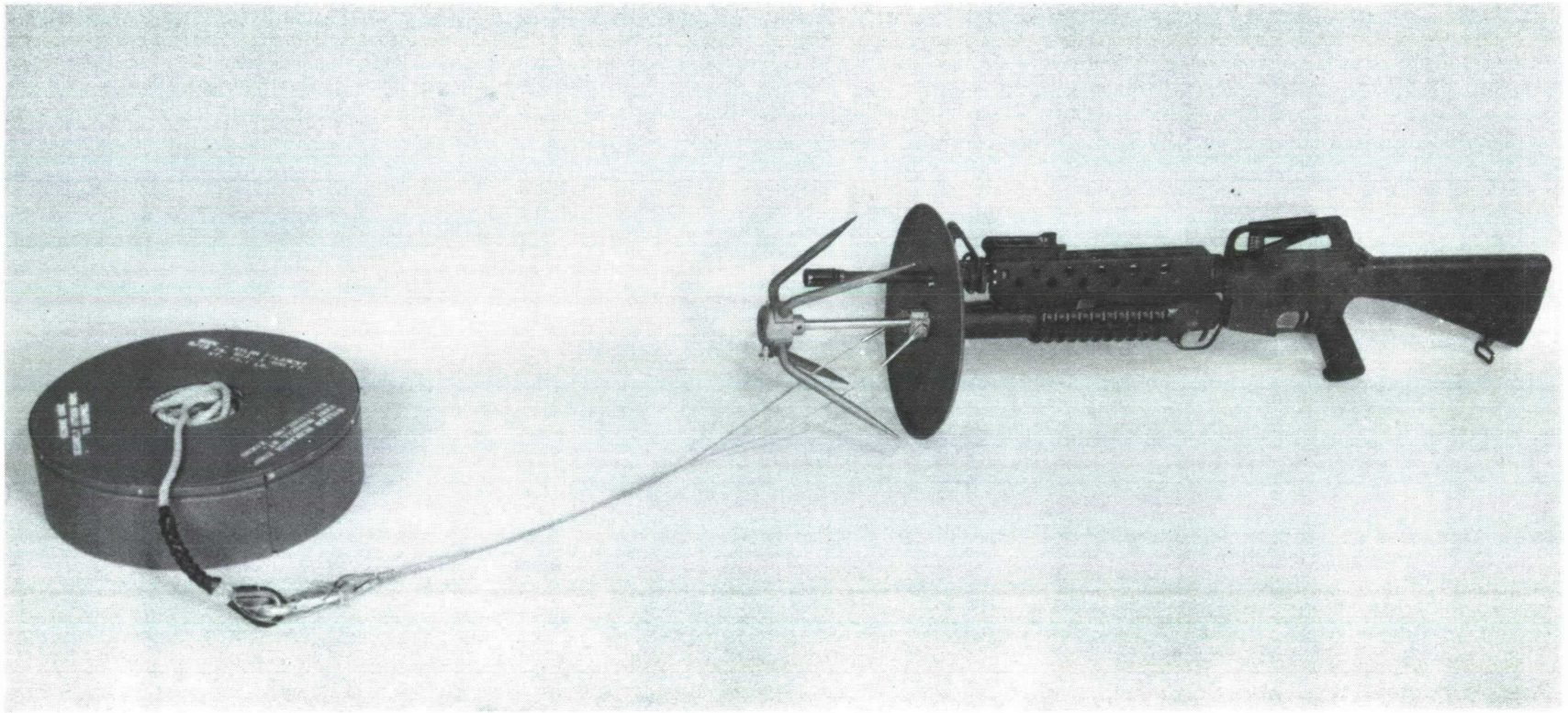

Figure 1. Grapnel System

Figure 2. Grapnel Bandoleer and Line Bandoleer

Figure 3. Line Bandoleer

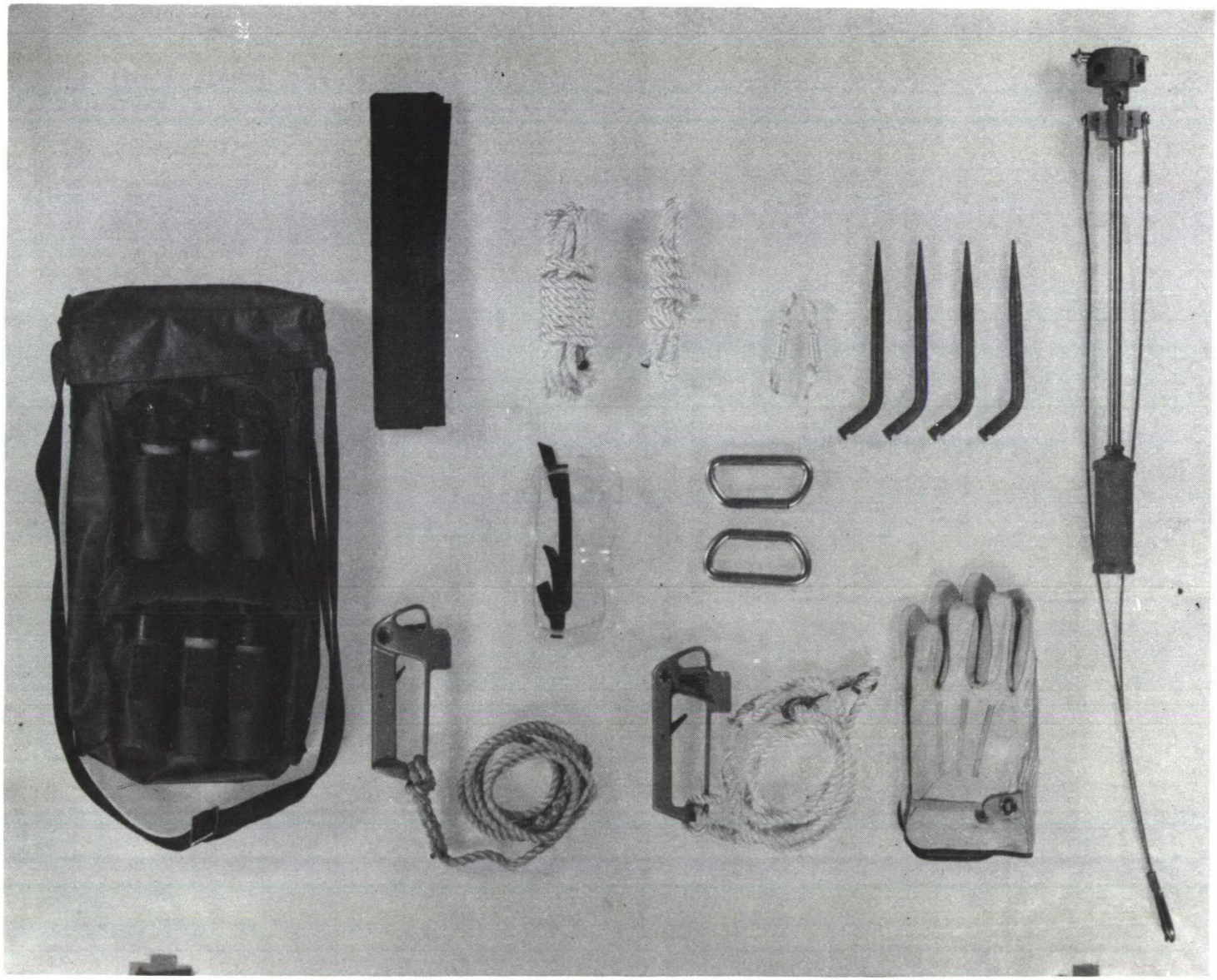

Figure 4. Grapnel Bandoleer

DEVELOPMENT AND TESTING

General

The Engineer Tests and Service Tests (ET/ST) USATECOM Project No. 8-EG-155-000-001 of the original Grapnel System resulted in five (5) deficiencies and seven (7) shortcomings.

Deficiencies:

1. The rope did not meet the requirement for withstanding impact loads of 225 lbs in a sudden vertical drop of five feet.
This deficiency was corrected by color coding the fifteen feet of rope next to the grapnel hook and inserting a note in the instruction manual requiring the first individual up the rope to securely fasten the rope.

2. The rope did not provide a non-skid hand grip, and produced injury to bare hands.
This was corrected by providing a pair of gloves in the package.

3. The rope frayed from contact with abrasive surfaces.
This was corrected by providing a note in the instruction manual to visually inspect the rope and insert one of the bandoleer covers between the rope and any abrasive surface.

4. The climbing devices separated from the rope.
This was corrected by modifying the climbing devices so that they could not separate from the rope.

5. The device did not meet the criterion for reaching heights of 150 ft.
User agreed to changing the minimum height to 140 ft.

Shortcomings:

1. Length of rope was supposed to be 400 ft. Measured length varied from 395 ft to 387 ft.
User agreed to changing specification on rope length to 400 ft, minus 40 ft.

2. The wire cable portion of the line burned during firings.
This was corrected by using a woven asbestos cloth covering.

3. The firing of the system was audibly detectable up to 800 meters.
User agreed to deleting the requirement for silent operation.

4. The grapnel hook shafts bent in seven of 71 firings against hard surfaces.
User agreed to accepting it as part of normal operation.

5. The design of the foot loops allowed the operator's feet to slip out.
This was corrected by providing "shoe strings" to tie the loop to the operators shoe.

6. Configuration of the climbing device resulted in operator's wrist fatigue.
This would not have happened if the operator had used the devices properly. However, a safety seat was provided so operator could sit and rest when part way up rope.

7. Functioning of the safety rope was inadequate.
This was corrected by providing a mountaineer's safety seat which functioned as a seat and as a safety line.
A letter In-Process Review was conducted and the above solutions were accepted. (Letter DARD-DDS-C to CRDLWL-9C, dated 24 Nov 71.)

Testing and Test Results

A check test of the XM1 launcher - propelled grapnel was conducted by the US Army Test and Evaluation Command (TECOM) at Aberdeen Proving Ground, MD from 12 July to 28 September 1973. Report APG-MT-4371 on TECOM Project #8-EG-155-000-003 states that previously reported deficiencies and shortcomings had been overcome, that there were no deficiencies in the system and that two new shortcomings were disclosed.

One shortcoming resulted from the impact of the rope snap disconnect on the rigid blast deflector at firings of around 75^{o} elevation. This resulted not only in an undesirable deforming of blast deflector but also was the basic cause of the second shortcoming, which was the failure to propel the grapnel with line to its required height of 140 feet. The mean peak height for the grapnel fired in the M203 launcher at 75^{o} was 137.1 feet.

The corrective action suggested by TECOM is to make the blast deflector more flexible so that it will not deflect the rope snap disconnect so much when it strikes the blast deflector. The TECOM report considers it likely that this relatively simple redesign could overcome both shortcomings; if not, the report recommends an increase of the total impulse of the cartridge to achieve the required height of 140 feet.

During an in-house testing by USALWL personnel the problem of the rope snap disconnect striking the blast deflector was experienced and readily overcome by extending the wire rope and safety hook straight away from the muzzle as far as possible and maintaining this position through the weight of approximately 8 or 10 feet of nylon rope. Adoption of this practice as a standard operating procedure appears to offer a simple solution to the problem which obviates the need for any further redesign and testing. An errata sheet to the Operator's Manual incorporating the procedure in the manual is being distributed.

CONCLUSIONS AND RECOMMENDATION

Conclusions

The Modified Grapnel with Line (Propelled), LWL Task 03-F-72, has been successfully modified to correct all of the deficiencies and shortcomings reported in the ET/ST.

The shortcomings disclosed in the check tests can be overcome by slight change in the launching procedure, as specified in the errata sheet being distributed.

Recommendation

It is recommended that the Modified Grapnel with Line (Propelled) be considered acceptable as standard Army equipment.

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